In re Appln. of Mark Christofis et al.
Serial No. 10/643,363
Preliminary Amendment Dated January 13, 2004

AMENDMENTS TO THE SPECIFICATION:

Please replace paragraph [0033] with the following amended paragraph:

[0033] While it is believed that the method of the present invention may be used for the induction heat treatment 1 of a number of articles 100 of the type described above, FIGS. 2, 3, 8 and 9 illustrate a particular embodiment of article 100, comprising a spider 200 of a tripod type constant velocity joint that Applicants have induction heat-treated using method 1. Spider 200 was generally cylindrical, having a hub 210 with a maximum diameter of about 100 mm and a thickness of about 40 mm and comprised AISI 1050 warm forged steel. Spider 200 comprised an outer surface 205, comprising hub surface 215, trunnion surfaces 235, and trunnion shoulder surfaces 245, and a core 240. Hub surface 215 was generally convex or barrel-shaped. Trunnion shoulders 225 were generally cylindrical, having a diameter of about 35 mm. In the embodiment illustrated in FIGS. 2 and 3, there were three trunnion shoulders 225, associated with three trunnions 220, however, the present invention is also applicable to hubs 210 that contain more or less than three trunnions 220 or shafts. Trunnions 220 were about 40 mm long and 30 mm in diameter. Hub 210 also comprised a bore ~~250~~ 260, which was a splined bore, and is the means for attaching spider 200 to an axle shaft (not shown).

Please replace paragraph [0036] with the following amended paragraph:

[0036] Having selected 10 article 100, such as spider 200, the method of heat treatment 1 comprised the additional step of selecting 20 an induction coil 300. Referring to FIGS. 4-6, the induction coil 300 selected comprised a cylindrical coil 300 having a cylindrical portion 302, a termination portion 304, and a longitudinal axis 306. Cylindrical portion 302 of induction coil 300 also preferably comprises an integral quench ring 308 that is fabricated so as to form an integral portion of cylindrical portion 302. Due to the fact that quench ring 308 extends inwardly of the inner sidewall of cylindrical portion 302, it

also acts as a flux concentrator, such that the magnetic field is strongest and most closely coupled to article 100 within the bore of quench ring 308. Referring again to FIGS. 4-6, induction coil 300 may comprise any suitable size, cross-sectional shape and composition, depending on the exact nature of article 100 that is to be used therewith. However, in the case of spider 200, induction coil 300 had an effective inner diameter of about 38 mm and comprised a hollow, rectangular, copper tube having an internal width of 12.5 mm and an internal height of 12.5 mm, and a sidewall thickness of 2-3 mm. While many conductive materials may be used for induction coil 300, it is preferably made from pure copper tubing, generally having a purity of at least 99%. Induction coil 300 must be adapted so as to receive article ~~200~~ 100, while preferably maintaining as close a spacing as is practicable, so as to maximize the inductive coupling with article 100 when induction coil 300 is energized, and yet not interfere with the rotation or withdrawal of article 100, as discussed below. Induction coil 300 is preferably adapted so that longitudinal axis 306 of coil 300 may be easily aligned to be parallel to and coincident with trunnion axes 230.

Please replace paragraph [0039] with the following amended paragraph:

[0039] Referring to FIG. 7B, the next step of method 1 comprises rotating 40 ~~spider 200~~ trunnion 220 within induction coil 300 at a selected speed. This speed may be any suitable speed and may comprise a variable speed during or within the subsequent steps of method 1. Rotation is used to compensate for the fact that induction coil 300 has a region where the return legs 312 and 314 of termination portion 304 and generally cylindrical portion 302 meet where the resultant magnetic field is non-uniform and generally reduced as compared to adjacent sections of induction coil 300. In the case of the application of method 1 to spider 200 described herein, the rotational speed was about 100-200 rpm, preferably about 150 rpm.

Please replace paragraph [0042] with the following amended paragraph:

[0042] The next step of method 1 comprises cooling 70 trunnion surface 235 and trunnion shoulder surface 245 of article 100 to a temperature (TC) to the selected case 250 depth. This temperature (TC) can be any temperature that is lower than the heat treatment temperature (TH), but typically will be selected to produce certain desired transformation products within case 250. In the case of spider 200, the desired transformation product in case was martensite, hence, TC was selected to be below the martensite transformation temperature, which in the case of AISI 1050 was about 200°F. Cooling 70 comprised quenching trunnion in an aqueous quenchant comprising 3-5% of a commercially available polymer quenchant additive, Aqua Quench 251, for a time sufficient to cool trunnion surface 235 and trunnion shoulder surface 245 below TC. Quenching was accomplished by pumping a large volume of the quenchant through inductor coil 300 and quench ring 308 onto the trunnion surface 235 and trunnion shoulder surface 245. Quenching 70 was accomplished using quench ring 308 having a plurality of spray holes 310 in the lower surface of quench ring that were directed radially inwardly and downwardly towards longitudinal axis 306 of induction coil ~~200~~ 300 as shown in FIGS. 7D and 7E. The quench time corresponded with the scan of trunnion 220 within induction coil 300, and for spider 200 was about 5 seconds. The quenchant flow rate was about 10 gpm.